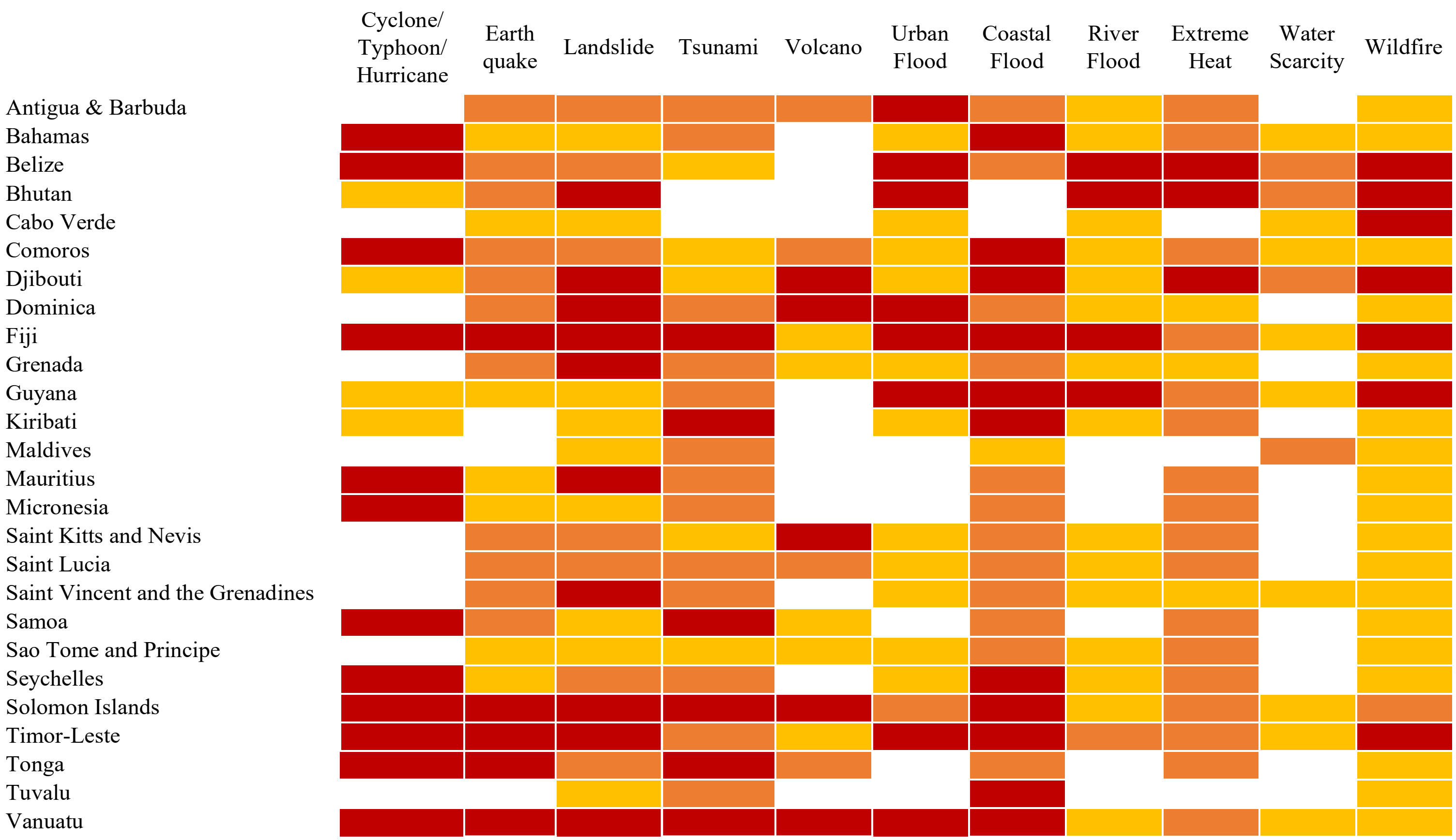
Annex 1. Country Sample

	Income Group	Region	Island States	Costal	Landlocked
Antigua & Barbuda	High-income	WHD	Y		
Bahamas	High-income	WHD	Y		
Belize	Upper middle-income	WHD		Y	
Bhutan	Lower middle-income	APD			Y
Cabo Verde	Lower middle-income	AFR	Y		
Comoros	Lower middle-income	AFR	Y		
Djibouti	Lower middle-income	MENA		Y	
Dominica	Upper middle-income	WHD	Y		
Fiji	Upper middle-income	APD	Y		
Grenada	Upper middle-income	WHD	Y		
Guyana	Upper middle-income	WHD		Y	
Kiribati	Lower middle-income	APD	Y		
Maldives	High-income	APD	Y		
Mauritius	Upper middle-income	AFR	Y		
Micronesia	Lower middle-income	APD	Y		
Saint Kitts and Nevis	High-income	WHD	Y		
Saint Lucia	Upper middle-income	WHD	Y		
Saint Vincent and the Grenadines	Upper middle-income	WHD	Y		
Samoa	Upper middle-income	APD	Y		
Sao Tome and Principe	Lower middle-income	AFR	Y		
Seychelles	High-income	AFR	Y		
Solomon Islands	Lower middle-income	APD	Y		
Timor-Leste	Lower middle-income	APD	Y		
Tuvalu	Lower middle-income	APD	Y		
Vanuatu	Lower middle-income	APD	Y		
Total SDS	**25**		**21**	**3**	**1**

Sources: WEO (2019)

Note: IMF Guidance Note (IMF 2018) classifies SDS in four income groups: (i) high-income SDS, as countries with GDP per capita above US$12476, (ii) upper middle-income, as countries with GDP per capita between US$4036 and US$12475; (iii) lower middle-income SDS as countries with GDP per capita between US$1026 US$4035; and (iv) low-income SDS with GDP per capita below US$1025. Our sample does not include low-income SDS.

Annex 2. An indication of National Hazard Categories and Intensities in SDS



Source: ThinkHazard, GFDRR. .

Notes: ThinkHazard indicates the intensity of potential natural hazards and disasters by calculating the probability of frequency and severity. Red shows a climate-related disaster with high severity and frequency; Orange– a potentially damaging disaster that is expected to occur in a human lifetime; Yellow—a low or very low potentially damaging event less likely to occur in a human lifetime. The ThinkHazard exposure profiles have been used as a comparable example of the possible set of hazards across all SDS included in this study, however, the ThinkHazard assessment is not always complete due to a lack of comparable data. For example, some Caribbean islands such an Antigua and Barbuda, Dominica, Grenada, St Kitts and Nevis, St Lucia and St Vincent and the Grenadines are vulnerable to the impacts caused by hurricanes. Detailed individual country and regional assessments are needed to fully understand the costs of resilience in each country.

Annex 3. Selected Data Sources

Education	**Energy**	**Health**	**Roads**	**Water and Sanitation**
WEO 2019	WEO 2019	WEO 2019	WEO 2019	WEO 2019
	IRENA			
Notre Dame-Global Adaptation Initiative (ND-GAIN),	Notre Dame-Global Adaptation Initiative (ND-GAIN),	Notre Dame-Global Adaptation Initiative (ND-GAIN),	Notre Dame-Global Adaptation Initiative (ND-GAIN),	Notre Dame-Global Adaptation Initiative (ND-GAIN),
Global Risk Index	Global Risk Index	Global Risk Index	Global Risk Index	Global Risk Index
World Bank Estates database (number of teachers, teacher to student ratio, enrolment rates)	World Bank World Development Indicators (current access to electricity, per capita electricity consumption)	WHO Global Health Observatory (doctor density, ratio of doctors to all other medical staff)	World Bank (Rural Access Index, population density, economic shares of manufacturing and agriculture)	Hutton and Varughese (2016)
UNESCO (share of non-teacher wages in current spending, shares of current no compensatory and capital spending)		World Bank (share of doctor and nondoctor compensation in total spending)	CIA Factbook and International Road Federation World Road Statistics (current number of road kilometers, country area)	Burdescu and others (2020)
World Bank (HDI, WDI, GFDRR)		OECD Health statistics (ratio of nondoctor compensation to doctor compensation)		
UNICEF				
UNSTAT	UNSTAT	UNSTAT	UNSTAT	UNSTAT
UNFCCC	UNFCCC	UNFCCC	UNFCCC	UNFCCC

Source: Gaspar and others (2019); Authors.

Annex 4. Summary Statistics

	Climate Vulnerability	Rating of climate-related loss/GDP 1999-2018	Greenhouse Gas Emissions	Policy and Institutional Readiness to Climate Change	Health Outcomes (Adjusted)	Education Outcomes (Adjusted)	Renewable Energy Generation Target	Rural Access Index	Access to Basic Water Services	Health Spending (latest available)	Education Spending (latest available)
	(index 0 less to 1 more)	(rank 1 max loss to 180)	(% of total)	(index 0 less to 1 most)	(score 0 less to 10 more)	to add	(in % of total)	(0-100)	(% of total population)	(% of GDP)	(% of GDP)
Median											
Lower Middle-Income	0.54	28.00	0.00	0.38	0.23	0.45	50.00	77.00	84.00	5.17	7.86
Upper Middle-Income	0.44	15.00	0.00	0.45	0.43	0.55	85.00	78.00	96.50	5.24	4.61
High-Income	0.48	14.00	0.00	0.43	0.55	0.60	50.00	83.50	98.00	5.76	3.00
Median											
APD	0.53	14	0.0	0.42	0.28	0.45	85	77	93	5.21	6.74
WHD	0.46	10.00	0.00	0.45	0.55	0.57	50	85	97	4.95	3.65
SSA+MENA	0.49	135	0.0	0.30	0.34	0.62	45	80	86	5.46	6.04
Total SDS			**0.08**								
Median SDS	**0.48**	**16**		**0.42**	**0.33**	**0.51**	**70**	**81**	**96**	**5.24**	**5.56**
Average SDS	**0.49**	**40**		**0.40**	**0.66**	**0.52**	**68**	**80**	**91**	**6.41**	**6.16**

Sources: Global Climate Risk, IMF , NDCs, ND-GAIN, UNICEF, World Bank (WDI, HDI), WHO.

Annex 5. Tax Capacity Estimates using Stochastic Frontier Analysis (SFA)

This annex discusses briefly the methodology used to estimated tax capacity in 19 SDS using an SFA (Martinez-Vazquez and others 2013) and provides the main results. The methodological approach follows Langford and Ohlenberg (2016) in the sense that we use a time varying true random effects model which takes into account random shocks, accounts for heterogeneity within the panel, and distinguishes between invariable or persistent structural factors and time-varying factors affecting countries' tax effort. However, we use a different specification to the one used by Langford and Ohlenberg (2016). Our specification is tailored, and the sample is limited to SDS to capture their unique characteristics compared to larger economies. This may lead to a different frontier compared with larger economies.[42] Furthermore, to better capture SDS features, we adjust and augment the standard set of explanatory variables used in the literature. The chosen specification attempts to mimic the most important tax bases from which SDS collect revenue. Another advantage of this selective approach is that targeted estimates –that also account for SDS data limitation–allow us to estimate tax potential for SDS usually omitted in the empirical work in this area.

Methodology

An SFA models a production function (Equation 1) in which inputs—X_{it}—are transformed into tax revenues (TR_{it}) for country i in year t. In this approach, countries potentially collect less than it would be possible due to a level of inefficiency (E_{it}), this is random normally distributed and independent of the inefficiency shocks (V_{it}).

$$TR_{it} = f(X_{it}, \beta).\ E_{it}.\ exp^{V_{it}}; \qquad (1).$$

A set of inputs X_i includes Gross National Income, the size of agriculture and tourism sectors, the government wage bill and a measure of geographic dispersion. If E equals 1, the country collects the maximum tax revenues possible, using the inputs.

The natural logarithm form of Equation (1) provides the basis for the basic econometric model as proposed by Aigner and others (1977):

$$ln(TR_{it}) = ln[f(X_{it}, \beta)] + ln(E_{it}) + \nu_{it;} \qquad (2).$$

Assuming the tax revenue input function $[f(X_{it}, \beta)]$ is linear in logarithms and defining the inefficiency as $u_{it} = -ln(E_{it})$:

$$ln(TR_{it}) = \alpha + \Sigma\beta\ ln(X_{it}) + \nu_{it} - u_{it}; \qquad (3).$$

[42] Estimating the frontier for a subset of countries with unique characteristics has been applied to countries with abundant natural resources (Fenochietto and Pessino 2013) and in Sub-Saharan Africa (Caldeira and others 2020).

Following Langford and Ohlenburg (2016) and using the specification (3), we use a time-varying inefficiency model for panel data that accounts for observable heterogeneity (Battese and Coelli 1995). The parameters of the stochastic frontier and the inefficiency model are estimated simultaneously to avoid bias. The unobserved time-invariant heterogeneity is captured in a "true random effects" model.[43] As in Langford and Ohlenburg (2016), we interpret unobserved heterogeneity as a lack of tax effort, suggesting that the influence of the unobserved factors could be overcome with tax policy and administration measures.

Data

We begin with 25 SDS listed in Annex 1 over the period from 1995 to 2019. Data are taken from the WoRLD, World Economic Outlook, World Development Indicators, International Financial Statistics and World Tourism Organization databases. Data on public sector employment and wage bills come from Gupta and others (2016). Data for selected indicators restrict our sample to 19 SDS: Antigua and Barbuda, the Bahamas, Belize, Cabo Verde, Comoros, Dominica, Grenada, Guyana, Maldives, Mauritius, Micronesia, Samoa, Seychelles, St. Kitts and Nevis, St. Lucia, St. Vincent and the Grenadines, Sao Tome and Principe, Timor-Leste and Vanuatu.

Appendix Table 1. Summary Statistics

Variables	High-Income	Upper Middle-Income	Lower Middle-Income	Entire sample average	Sample median	Observations
Tax revenue (without social security contribution) % of GDP	17.7	20.2	14.3	17.2	17.5	659
Gross National Incomeper capita in constant US$	14,049.7	4,878.3	2,311.9	5,185.0	3,051.8	565
Geographic dispersion (in sq. km)	79,902.8	60,093.4	403,661.6	198,839.5	45,389.3	690
Value added in agriculture (% of GDP)	2.8	11.6	21.8	13.7	11.6	646
Tourism receipts (% of GDP)	34.8	18.5	8.6	18.0	16.1	561
Government wage bill (% of GDP)	9.2	9.4	11.2	10.0	9.4	536

Empirical Results

Table 2 indicates the coefficients in the models used to estimate the maximum level (capacity) of tax revenue that could be theoretically mobilized given an SDS' economic structure and

[43] Greene (2005). It is important to note that the choice of how to model unobserved time-invariant heterogeneity in SFA can have a substantive impact on the estimated size of inefficiency (tax effort).

prevailing economic conditions.[44] The larger is the gap between the actual and theoretical tax revenue, the larger is scope for tax policy and revenue administration to reach the potential tax revenue. The gap for SDS is reported in Figure 7 of the main text.

The sign and statistical significance of the coefficients in the models are consistent with the literature, but also capture a specific economic and institutional structure of SDS.

Appendix Table 2. Stochastic Frontier Analysis Coefficients

VARIABLES	Tax revenue
Frontier	
Ln (per capita Gross National Income)	0.160***
	(0.0205)
Ln (Tourism receipts as a share of GDP)	0.0265*
	(0.0139)
Ln (Agriculture as a share of GDP)	-0.159***
	(0.0215)
Ln (Public sector wage bill as a share of GDP)	0.0888***
	(0.0235)
Ln (Geographical dispersion)	0.0217***
	(0.00843)
Constant	1.386***
	(0.203)
Inefficiency	
Usigma	-4.718***
	(0.537)
Vsigma	-4.780***
	(0.208)
Theta	0.286***
	(0.0105)
Observations	297
Number of countries	19

Standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

- **Economic development**. Tax revenues increase with the country's income level and economic development as higher-income countries (society) has a higher ability to pay taxes (Bahl 1971). We use Gross National Income per capita—accounting for both GDP and

[44] Estimates of alternative specifications and robustness tests—available upon request—are broadly in line with the baseline.

remittances from the diaspora particularly significant in SDS—to capture the impact of these variables on tax revenue potential in SDS.

- **Sectoral development**. Tax revenues are unusually lower in countries with a larger share of agriculture in GDP. This sector is characterized by a higher number of tax exemptions, small producers, and a higher level of informality (Fenochietto and Pessino, 2013). In contrast, tax revenues are higher in countries with larger tourism receipts (as a share of GDP) as this sector is comprised of larger hotels and transportation companies (Glenday and others 2019).

- **Size of the public sector**. The impact of the public sector on tax revenue is ambiguous. On one side, in many developing countries, the public sector contributes to the bulk of personal income tax revenue. Hence, a larger public sector would imply higher taxes. On the other hand, a large public sector can indicate a less diversified economy and a narrowing of the tax base (e.g., the public sector does not pay corporate income tax), contributing to lower tax revenues. Our estimates indicate a positive coefficient associated with the size of the public sector—as a key economic actor—in SDS.

- **Geographic characteristics.** The main text stresses the impact of geographic location and dispersion on sustainable development and climate resilience goals. These characteristics are difficult to approximate by existing indicators. We use a distance in kilometers between the extreme north-south and east-west borders of each SDS to capture the dispersion and multiply it by import deflators to capture the impact of some SDS' distant location. The role of geographic characteristics on tax revenue is ambiguous. On the one hand, geographic dispersion may reflect a country's size, which is positively correlated with tax revenue. On the other hand, tax collection may be weaker in more 'disperse' countries with lower collection capacities. Our estimates indicate a positive relationship.

ANNEX 6. EXAMPLES OF 'CLIMATE FUNDS'

Global Environment Facility (GEF). Countries are eligible for GEF funding if they have ratified UNFCCC. The GEF is used for a range of climate and environment-related projects and operates through 18 partner agencies, which are selected to deploy funds. These are the only institutions that can access GEF funding directly. Special funds include the Special Climate Change Fund , which supports adaptation and technology transfer and the Least Developed Countries Fund , which is accessible specifically to LDCs that are vulnerable to adverse impacts of climate change.

Green Climate Fund (GCF). A range of instruments, including grants, concessional loans, etc., that support the delivery of the NDCs. Developing country parties to UNFCCC are eligible. The GCF requires both a nationally designated authority and an Accredited Entity . Organizations seen to have specialized capacities in climate action may apply to be an Accredited Entity and can be private, public, non-governmental, sub-national, national, regional or international. The fund supports eight impact areas across two broad categories: low-emission sustainable development and increasing climate-resilience.

Climate Investment Funds (CIF). Concessional finance is provided to accelerate climate action by empowering transformation in clean technology and renewable energy sources, making them cost-competitive with fossil fuels (e.g., Climate Investment Fund 2019). Recipient countries must meet the Official Development Assistance eligibility criteria and have an active MDB program. Specific funds include the Clean Technology Fund , the Pilot Program for Climate Resilience and the Scaling Up Renewable Energy in Low Income Countries Program .

Adaptation Fund. Grants are provided to developing country members of the UNFCC list of parties, and financing flows through accredited implementing entities. Investments predominately support food security, agriculture, water management and disaster risk reduction projects for the promotion of community resilience.

Climate Funds for preparedness and response. Activities that address the impacts of hazards are also available to SDS. This support is provided both through MDBs and climate funds. The ***Global Facility for Disaster Risk Reduction and Recovery (GFDRR),*** for example, targets the most disaster-prone countries and provides grants in support of building resilience and enabling recovery. Through its ***Small Island States Resilience Initiative (SISRI),*** technical assistance supports small island states to build pipelines of resilient investments to withstand climate change impacts.

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